found in petroleum. It gives, by the proper reactions, a considerable quantity of a primary alcohol, and a smaller quantity of a secondary one; the latter is not identical with methyl-hexyl carbinol, but consists most probably of ethyl-amyl carbinol, $\left.\begin{matrix} C_2 H_5 \\ C_5 H_{11} \end{matrix}\right\}$ CH OH, as, on oxidation, it yields valerianic and propionic acids.

The primary alcohol appears to differ from the primary octyl alcohol, which has been found lately by Zincke in the seeds of *Heracleum spondylium**. The essential oil of these seeds consists chiefly of an octyl acetate, boiling at 206°–208°, and possessing an orange-like smell, whilst that which I obtained smells strongly of pears, and boils at 198°–202°. By oxydising his alcohol, Zincke obtained a caprylic acid, which solidified at 12°, whilst the acid which I got remained liquid at 0°. Zincke's alcohol is most likely the normal alcohol, and that which I obtained an alcohol containing the group isopropyl†.

(3) On acting upon the hydrocarbons of the series $C_n H_{2n+2}$ with chlorine, a mixture of primary and secondary chlorides is formed. This is proved by the fact that the alcohols derived from these chlorides yield, on oxidation, besides an acid containing the same number of atoms of carbon as the alcohol, also acetones, or the characteristic oxidation products of secondary alcohols. Not only the above researches show this, but also my former experiments on the oxidation of amyl-alcohol prepared from the hydride, which gave, besides valerianic acid, also acetic acid and the acetone, $C_5 H_{10} O$‡.

It is certainly very remarkable that the hydrocarbon from petroleum yields *methyl-hexyl carbinol*, whilst the hydrocarbon which is obtained from methyl-hexyl carbinol is not reconverted into this alcohol, but gives *ethyl-amyl carbinol*, and besides a primary alcohol.

The further investigation of this subject is certainly of the highest theoretical interest; but there is great difficulty in pursuing this research, as I have already observed, in consequence of the small yield of pure alcohol from large quantities of the hydrocarbons.

XVI. "On the Derivatives of Propane." By C. Schorlemmer. Communicated by Prof. Stokes, Sec. R.S. Received June 17, 1869.

The chief product obtained by the action of chlorine upon propane consists, as I have already stated in my last communication §, of propylene dichloride; besides this compound, we find in smaller quantities the normal propyl chloride and products richer in chlorine, which boil between

* Zeitschrift für Chemie, N. F. vol. v. p. 55.

† Proc. Roy. Soc. vol. xvi. p. 379.

‡ Ibid. p. 374.

§ Ibid. No. 111, 1869.

100° and 200° C. To obtain the latter in larger quantities, I took those portions of the substitution-products which boiled above 80°, and passed chlorine into them for several days, having them exposed to direct sunlight, as in diffused light hardly any action took place. By this means a liquid was obtained which boiled between 120° and 200°. Subjected to fractional distillation, the greater portion boiled between 150° and 160°, but it was found impossbile to isolate a compound having a constant boiling-point. The reaction of this liquid, as well as the boiling-point and the analysis, show that it consists of *trichlorhydrine*, $C_3H_3Cl_3$, mixed with higher chlorinated products.

0·275 gave 0·8155 silver chloride.

Calculated for $C_3H_5Cl_3$.	Found.
72·20 per cent. Cl.	73·34 per cent.

The reaction most characteristic of trichlorhydrine is that, on heating it with caustic potash, it decomposes into hydrochloric acid and epidichlorhydrine, $C_3H_4Cl_2$, a liquid which boils at 100°, and which combines directly with bromine, forming the compound $C_3H_4Cl_2Br_2$, the boiling-point of which is 220°.

On heating the liquid, boiling between 150° and 160°, with powdered caustic potash, a violent reaction set in, and, besides water, a heavy oil distilled over, which possessed the somewhat garlic-like odour of epidichlorhydrine, and which boiled between 95° and 105°. The higher chlorinated products contained in the original liquid were destroyed by this reaction, carbonaceous matter being left with the potassium chloride in the retort. To the impure epidichlorydrine thus obtained bromine was added; this combined with it with a hissing noise and evolution of heat. On distillation, the greater portion of the compound boiled at 200°–220°; the part boiling between 215° and 220° was analyzed.

0·1835 of this compound gave 0·4455 of a mixture of silver chloride and silver bromide.

0·2955 of this mixture left, on heating it in a current of hydrogen, 0·1928 silver.

	Calculated.		Found.
C_3	36	13·28	——
H_4	4	1·48	——
Cl_2	71	26·20	26·3
Br_2	160	59·04	58·2
	271		

These experiments prove sufficiently that the liquid boiling between 150° and 160° contained a large proportion of trichlorhydrine. It is noteworthy to remark that the substitution-products of the primary propyl chloride are identical with those of the secondary chloride, as, according to Linnemann, on passing chlorine into isopropyl iodide, the products

which are formed are (1) the secondary chloride, (2) probably propylene dichloride, and (3) trichlorhydrine*.

In my last communication I have already called attention to the different behaviour of ethane and propane under the action of chlorine. A further instance is the formation of trichlorhydrine, the chemical structure of which is most probably expressed by the formula $CH_2Cl-CHCl-C_2HCl$, whilst by substituting 3 atoms of hydrogen by chlorine in ethane, the compound CH_3-Cl_3 is formed.

The liquid from which I had separated the trichlorhydrine was again treated with chlorine in the direct sunlight for several days. On distilling it afterwards, it came over between 200° and 250°. The portion boiling between 200° and 205° solidified in the receiver as a white, crystalline mass. In order to remove from it an oily liquid which it contained, it was pressed between filter-paper and recrystallized repeatedly from alcohol. The analysis conducted to the formula $C_3H_4Cl_4$.

(1) 0·1462 gave 0·5460 silver chloride and 0·0035 silver.

(2) 0·1282 gave 0·4051 silver chloride.

	Found.	
Calculated for $C_3H_4Cl_4$.	I.	II.
78·01 per cent.	78·02 per cent.	78·24 per cent.

Tetrachlorpropane, as this compound may be called, crystallizes from a hot alcoholic solution in small needles, four or eight of which are generally grouped together, forming a regular star. Its smell strongly resembles that of camphor. Exposed to the air, it volatilizes pretty quickly; heated in a test-tube, it fuses, subliming rapidly at the same time. In a sealed capillary tube it melted at 177°–178°, and solidified again at 176°–175°.

The liquid boiling between 205° and 250° was very little acted upon by chlorine even in the brightest sunshine and presence of iodine; also treatment with potassium chlorate and fuming hydrochloric acid produced little effect, as, after acting upon it for several days, the liquid boiled again between 220° and 250°. The portion boiling between 243° and 250° was analyzed:—

0·1926 gave 0·6580 silver chloride and 0·0034 silver.

Calculated for $C_3H_2Cl_6$.	Found.
84·86 per cent. Cl.	85·04 per cent.

This compound is therefore hexachlorpropane, $C_3H_2Cl_6$, a colourless, heavy liquid, which smells somewhat like camphor, and boils without decomposition at about 250°.

From these experiments it would appear that in propane we cannot replace by direct substitution more than six atoms of hydrogen by chlorine. This observation gains in interest by the fact that in sextane (hexylhydride) C_6H_{14}, from petroleum also not more than six atoms of hydrogen

* Annal. Chem. Pharm. vol. cxxxvi. p. 48, and vol. cxxxix. p. 17.

are replaceable by chlorine. Pelouze and Cahours* state that the last substitution-product of this hydrocarbon is the compound $C_6 H_8 Cl_6$. I repeated this experiment, and passed chlorine into pure sextane, first in the diffused and afterwards in the direct sunlight, as long as any action could be observed. Thus I obtained a heavy colourless liquid, which did not distil without decomposition, the analysis of which showed that it had the above composition.

0·1612 gave 0·4654 silver chloride and 0·0076 silver.

Calculated for $C_6 H_8 Cl_6$.	Found.
72·7 per cent. Cl.	72·8 per cent.

XVII. "On *Holtenia*, a Genus of Vitreous Sponges." By Wyville Thomson, LL.D., F.R.S., Professor of Natural Science in Queen's College, Belfast.

(Abstract.)

During the deep-sea dredging cruise of H.M.S. 'Lightning' in the autumn of the year 1868, the dredge brought up, on the 6th of September, from a depth of 530 fathoms, in lat. 59° 36′ N., and long. 7° 20′ W., about 20 miles beyond the 100-fathom line of the Coast Survey of Scotland, fine, grey, oozy mud, with forty or fifty entire examples of several species of siliceous sponges. The minimum temperature indicated by several registering thermometers was 47°·3 F., the surface temperature for the several localities being 52°·5 F.

The mud brought up consisted chiefly of minute amorphous particles of carbonate of lime, with a considerable proportion of living *Globigerinæ* and other Foraminifera, and of the "coccoliths" and "coccospheres," so characteristic of the chalk-mud of the warmer area of the Atlantic. The sponges belonged to four genera; one of these was the genus *Hyalonema*, previously represented by the singular glass-rope sponges of Japan and the coast of Portugal, and the other three genera were new to science. One of these latter was the subject of the paper.

Associated with the sponges were representatives, usually of a small size, of the Mollusca, the Crustacea and Annelides, the Echinodermata, and the Cœlenterata, with numerous large and remarkable rhizopods. Many of the higher invertebrates were brightly coloured and had eyes.

Four nearly perfect specimens of the sponge described in the memoir were procured.

Holtenia, n. g.†

H. Carpenteri, n. sp.

The body of the sponge is nearly globular or oval. Normal, and

* Comptes Rendus, vol. liv. p. 1241.

† The genus is named in compliment to M. Holten, Governor of the Faroe Islands, and the species is dedicated to Dr. W. B. Carpenter, V.P.R.S., with whom the author was associated in the conduct of the expedition.